

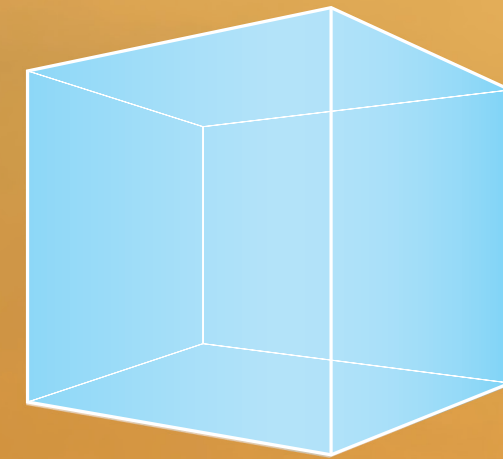
www.k-ensol.com



K-ENSOL

K-Ensol Korea(HQ)
K-Ensol USA
K-Ensol HUNGARY
K-Ensol POLAND
K-Ensol TÜRKIYE
K-Ensol GERMANY
K-Ensol SHANGHAI
K-Ensol VINA
K-Ensol MALAYSIA
K-Ensol INDONESIA
Samhyun BnE Korea

CLEAN For



We make the difference

K-ENSOL

K-ENSOL
Corporate Value System

“We make the difference”

Vision
Solution Inventor

Mission
Leading Technology, Solving Problems

Philosophy
Invent

Values

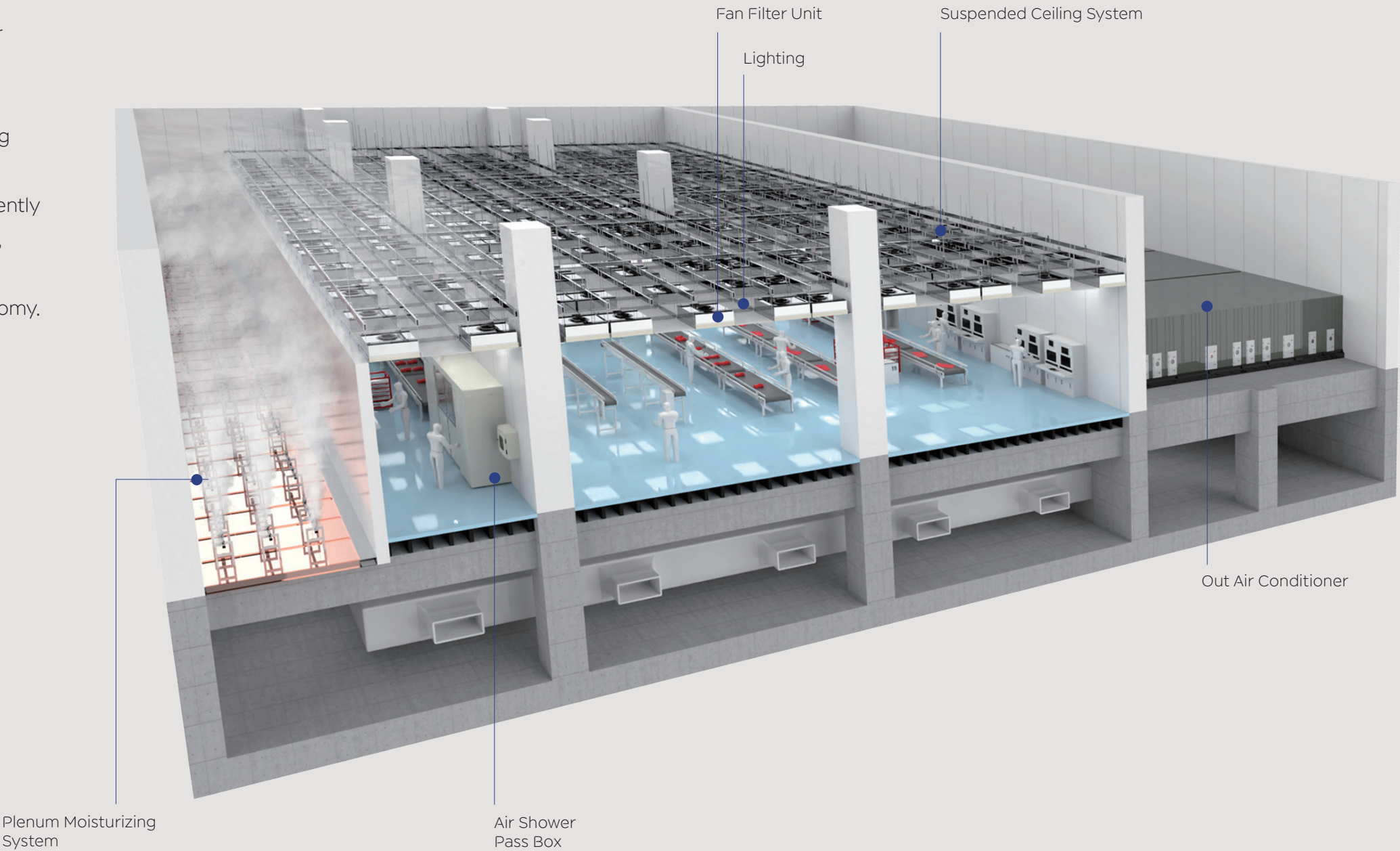


K-Ensol Clean Rooms are optimized for the production of semiconductors and display products

K-Ensol can construct large-scale super-clean rooms for semiconductor manufacturing plants size of 33,000 m² per line and for display manufacturing plants with a total area of approximately 73,000 m². On top of that, we also have the technology to keep clean rooms running efficiently. K-Ensol provides advanced clean room engineering, such as a suspended ceiling system, OAC, FFU and PMS, which are efficiently installed at each site. This can improve your business in semiconductors, display, IDC, precision machinery, medical devices, pharmaceuticals, and food facilities with environment management in a low-carbon economy.



With K-Ensol clean rooms, the occurrence of particles in an FAB can be controlled below the required level to manufacture the highest quality products with a high level of safety and productivity.



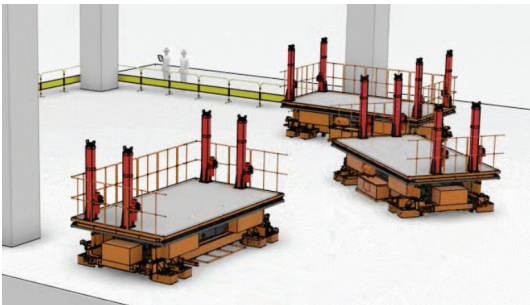
1 Modular System

Our unique modular construction method shortens your construction period, reduces workplace risk, and improves work efficiency.

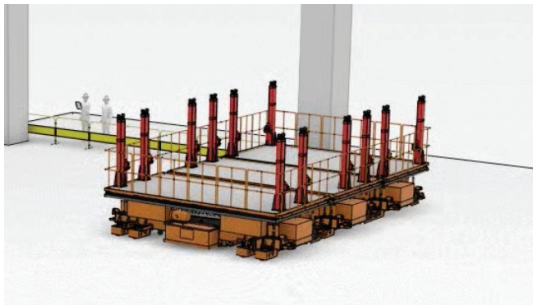
- Minimizes working at heights to ensure safety at worksites
- Ensures effective quality control through safe working environments, such as working at ground level and inspections
- Allows panels, ducts, and pipes can be assembled simultaneously and then installed
- Significantly shortens the construction period and improves work efficiency



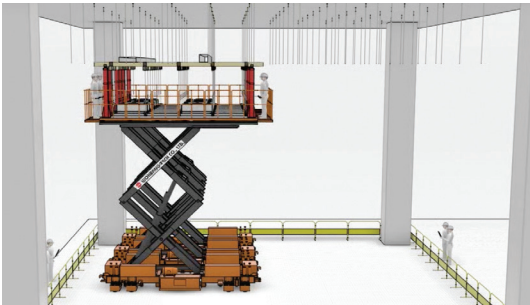
Multi-connected module lifts



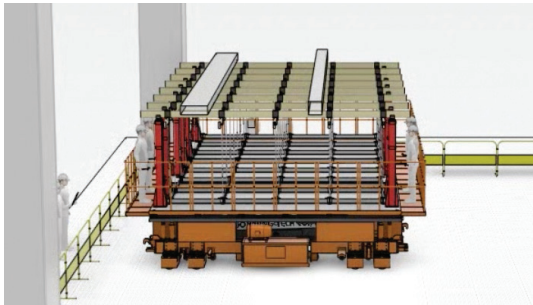
1. Lifts enter and move



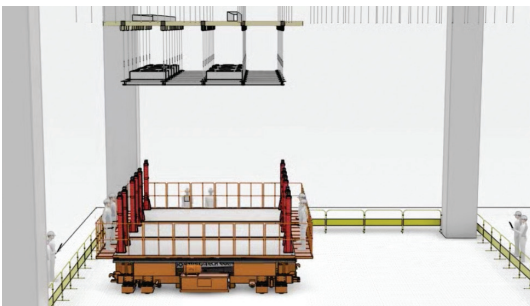
2. Lifts connect



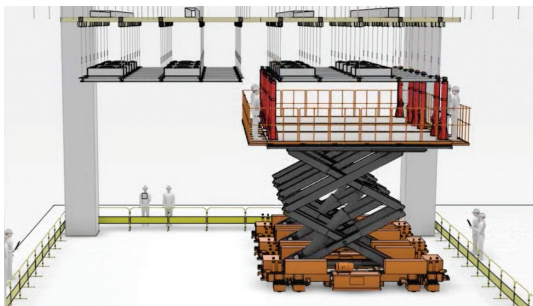
4. Lifts rise and install



3. Materials assembled at the ground level



5. Lifts descend and move



6. Modules assembled and installed

Effect of modularization 1

Reduction in
construction period by
17%

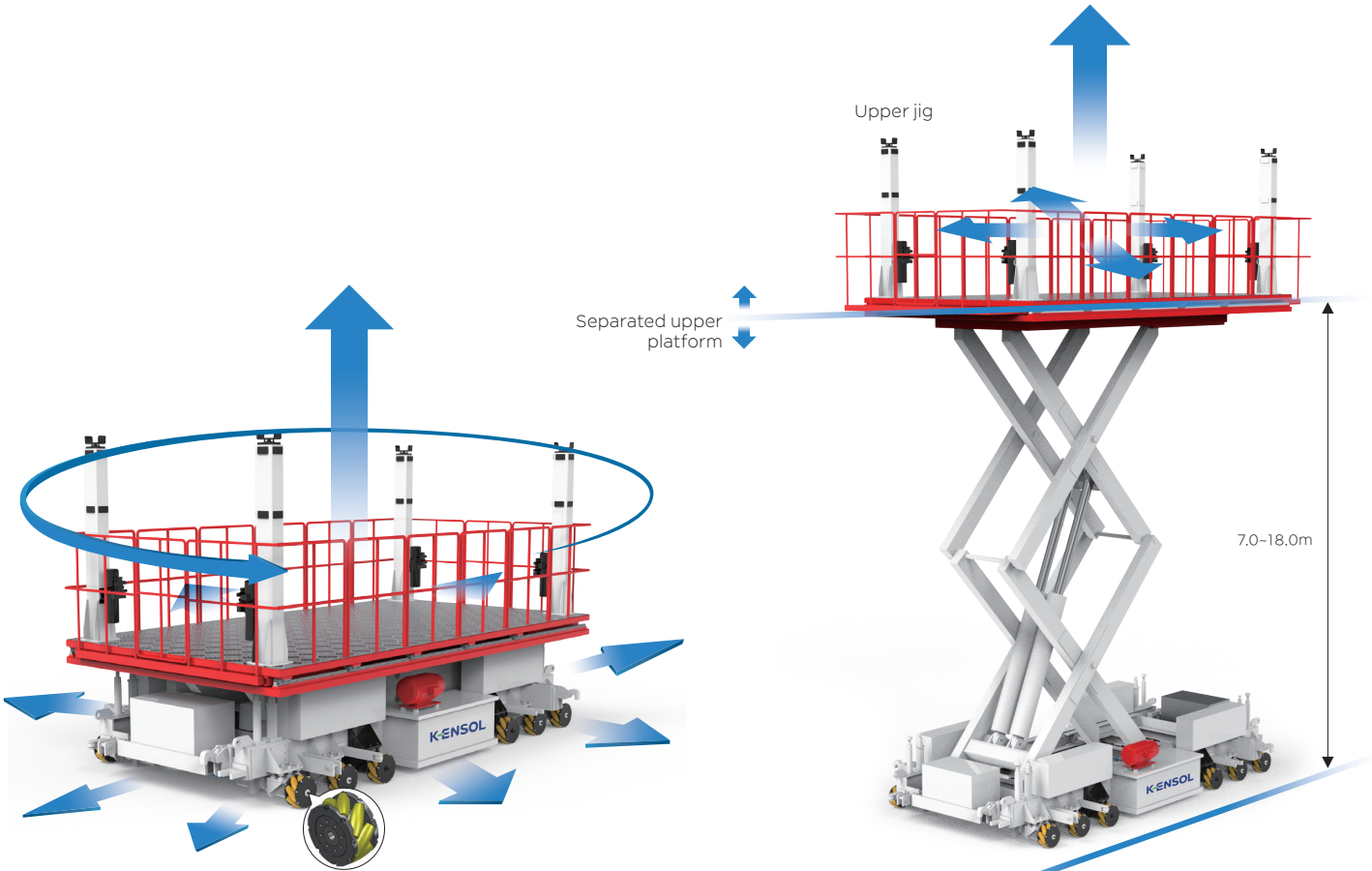
Case of Company 'S'

Effect of modularization 2

Reduce work at
heights by over
90%

Case of Company 'S'

· K-Ensol's modular construction method is best for architectural structures to which modular system is applied in the design stage.

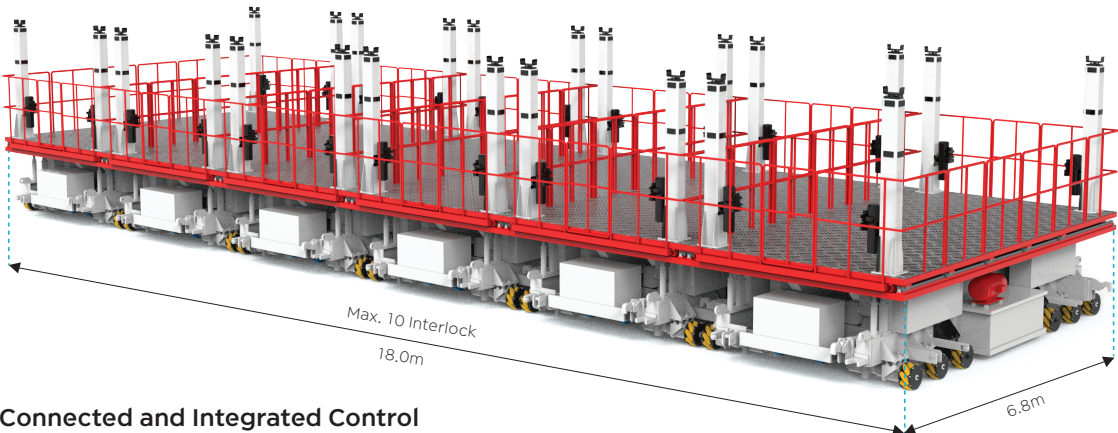


Module lifts are free to move and arrange themselves

- Omnidirectional Mecanum Wheel technology allows multiple lifts to be moved and rotated simultaneously
- Lifts can be aligned and moved by the millimeter in narrow spaces

Features

- The upper platform can be separated
- Standard lift height is 7.0m (up to 18.0m in height can be manufactured)
- X, Y, and Z axes can be moved precisely by using the upper jig

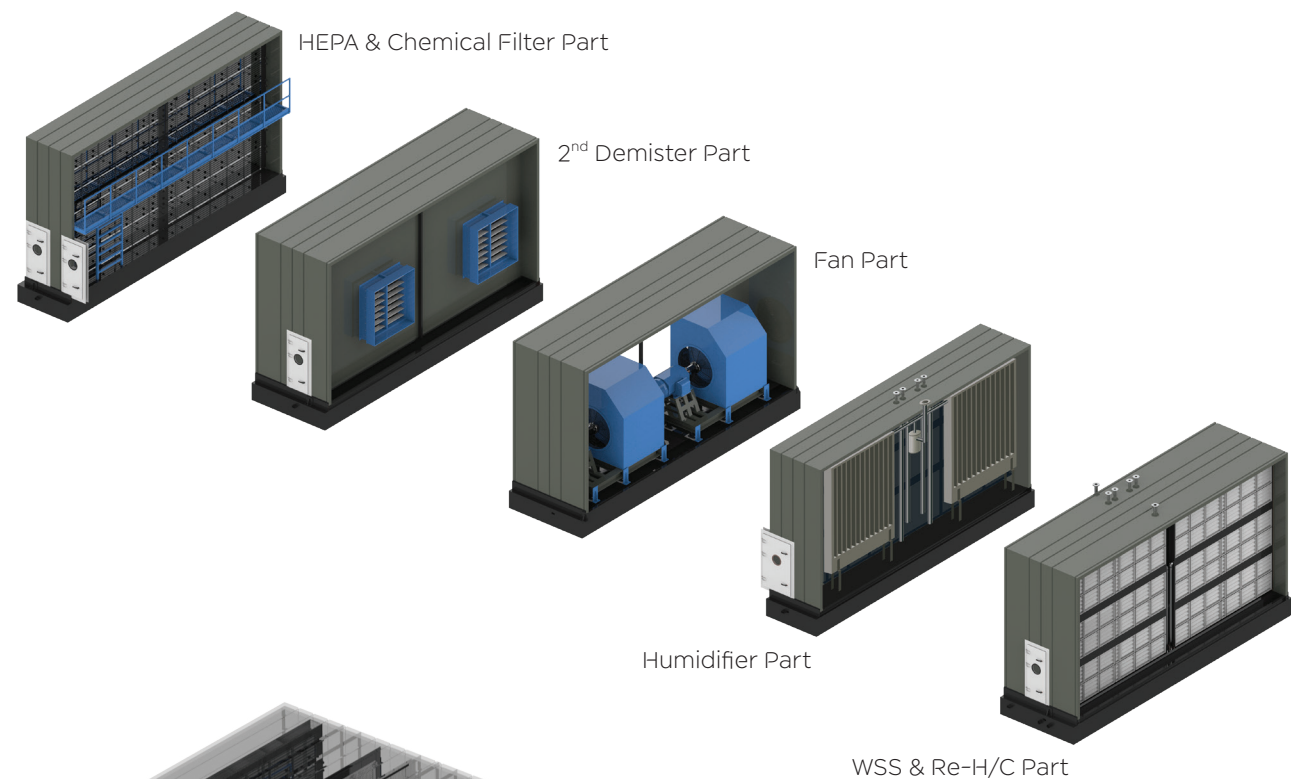


Connected and Integrated Control

- It's possible to choose the number of lifts connected(from 2 to 10), as per on-site conditions
- More heavy modules can be transported or lifted through the use of multi-connected lifts

2

Modular OAC Out Air Conditioner

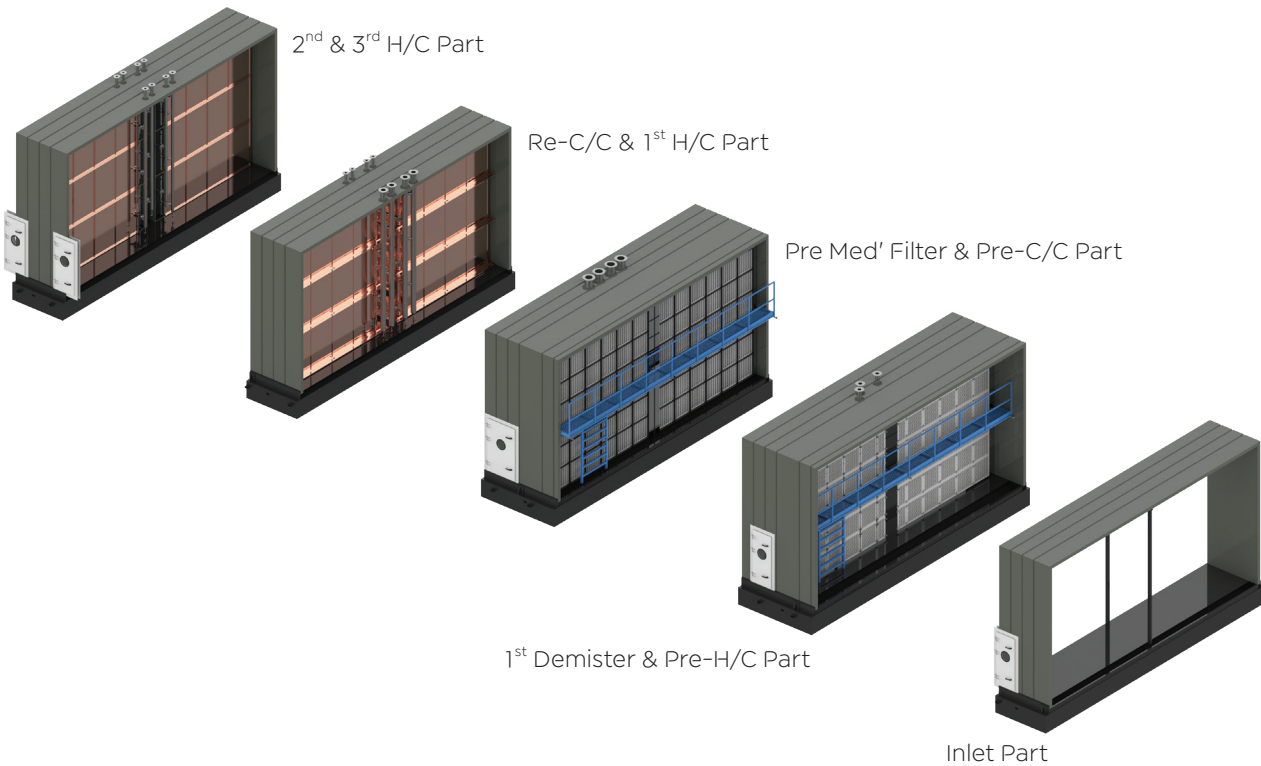


· OAC Module Type



Manufacturing and assembling Modular Out Air Conditioner reduces the number of on-site workers compared to the existing built-up method, and improves installation efficiency through uniform build quality.

- Compared to the built-up method, 55% less on-site workers are required
- Uniform quality is ensured by manufacturing the modular OAC units at the Plant in advance
- The construction period can be shortened by reducing the burden of foundation and plumbing work
- Running with only the minimal number of units required during the initial low load process is possible
- Optimization of supply air temperature according to process is possible



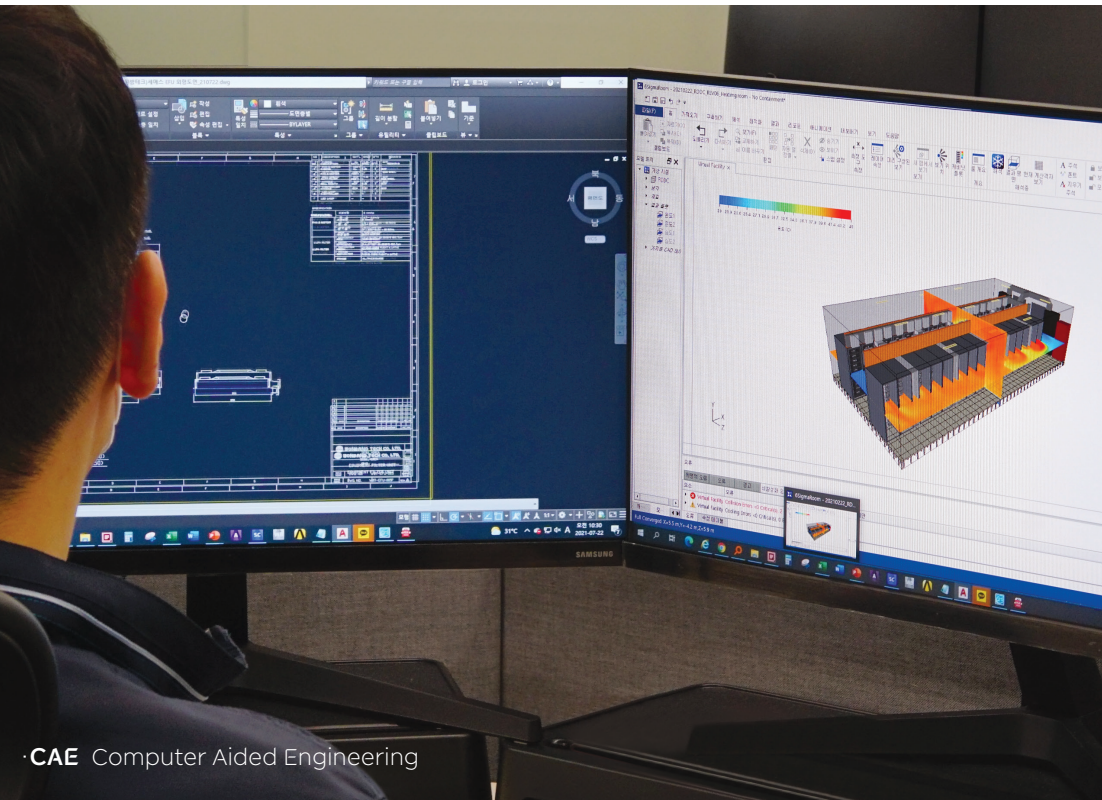
3

R&D:
Design, Simulation, Test

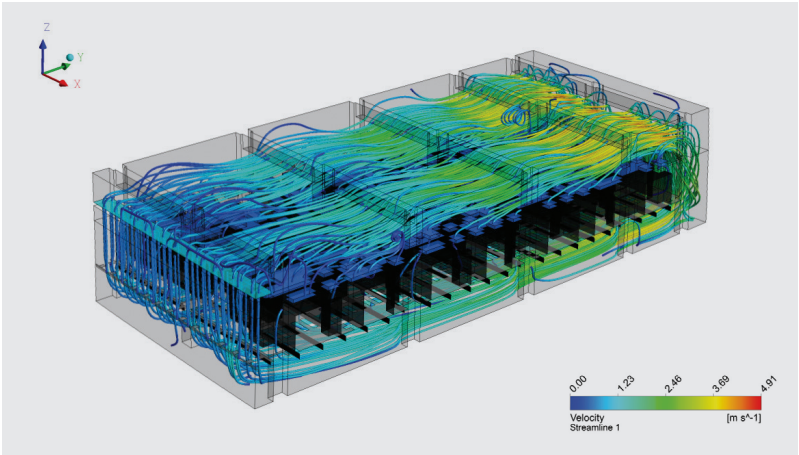
K-Ensol uses a test bed in clean room development and conducts rigorous structural analysis and varied simulations to deliver the most optimal designs.

Clean Room Development Through Test Bed and CAE Allows:

- Development of clean room equipment while securing retrofit capability
- Design and analysis of products with various tools
- Use of simulations to predict a problem and seek a solution

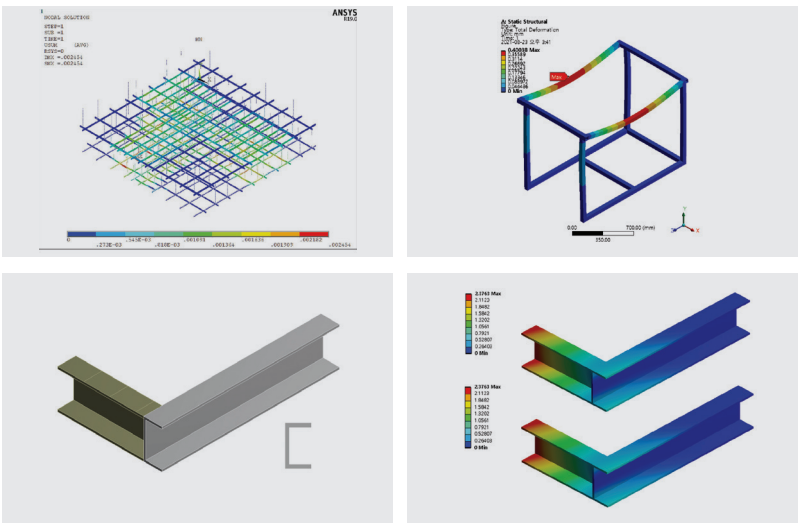


Fluid and Heat & Mass Transfer Simulation



- Analyze indoor pollutants, airflow, pressure distribution, temperature, and humidity
- Achieve optimal design by predicting and solving problems

Structural Analysis and R&D Test Bed



- Interpret the load, strain, and stress of the structure according to load conditions
- Review design feasibility through structural analysis and interpretation
- Ensure the performance of clean room equipment development through mock-up tests

Clean Equipment Test bed

- FFU
- EFU
- HEPA & ULPA Box
- HEPA & ULPA Filter
- BFU
- Panel Lighting

OAC Test bed

- WSS
- OAC
- Heating & Cooling Coil



4

Large-scale Production Plants and In-house Equipment Production

K-Ensol develops all clean room equipment itself and provides a one-stop total service that includes production, maintenance, and management.



Cheonan Plant 1 & 2

- Land area: 15,979m² (total floor area: 9,482m²)
- OAC, AHU, EFU, PMS, WSS, Dehumidifiers, LED panel lighting, and RDDC production



Asan Plant

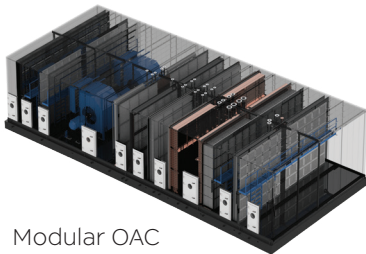
- Land area: 11,986m² (total floor area: 7,459m²)
- OAC, AHU, WSS, Dehumidifiers, and RDDC production



Georgia Plant, USA

- Total floor area : 5,593m²
- Dehumidifier, AHU, BCU, Clean Room Equipment

Main Products



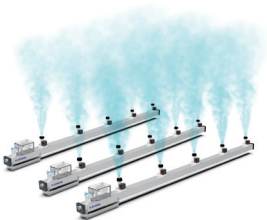
Modular OAC



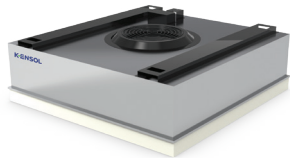
Dehumidifier



Rapid Deployment Data Center



Plenum Moisturizing System



Fan Filter Unit



Panel Lighting (Tube & Edge Type)

Domestic production capacity

List of Production	Monthly Production	Annual Production	Production Standards
OAC	8 Units	96 Units	4,000 CMM
FFU, EFU	5,000 Units	60,000 Units	1,500 X 1,300
PMS	200 Units	2,400 Units	D075 x 5N
WSS	1,496 Units	17,952 Units	-
DHU	28 Units	336 Units	Relative humidity 1%, Relative humidity 30% standard
BCU	100 Units	1,200 Units	500 CMM
AHU	55 Units	660 Units	500 CMM
Panel Lighting (LED)	1,760 Units	21,120 Units	1,200 X 1,200

US Plant (VP-ENSOL) production capacity

List of Production	Monthly Production	Annual Production	Production Standards
DHU	3 Units	24 Units	Ø1,240
BCU	30 Units	360 Units	-
AHU	8 Units	96 Units	21,000 CMM

Other Products



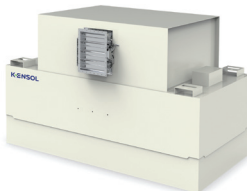
Bypass Cooling Unit



HEPA Filter Box



Air Shower



Blower Filter Unit



Pass Box



Modular Dry Cooling Coil

5

Turnkey Construction Capabilities

K-Ensol performs turnkey construction both within and outside of Korea with abundant experiences in designing, procuring, and constructing clean rooms on a comprehensive turnkey basis.

- Delivers high quality execution for each stage of design, procurement, and construction
- Prior turnkey constructions include OCI, TESNA, KoMiCo, WISOL, ZEUS, and ITEK
- Overseas turnkey projects can be carried out through our global network and experiences

K-Ensol has comprehensive construction planning, management, and coordination capabilities and provides efficient solutions for overall facilities. K-Ensol's brand, xREMS, represents our engineering philosophy of considering the environment and energy.



X

R

E

M

S

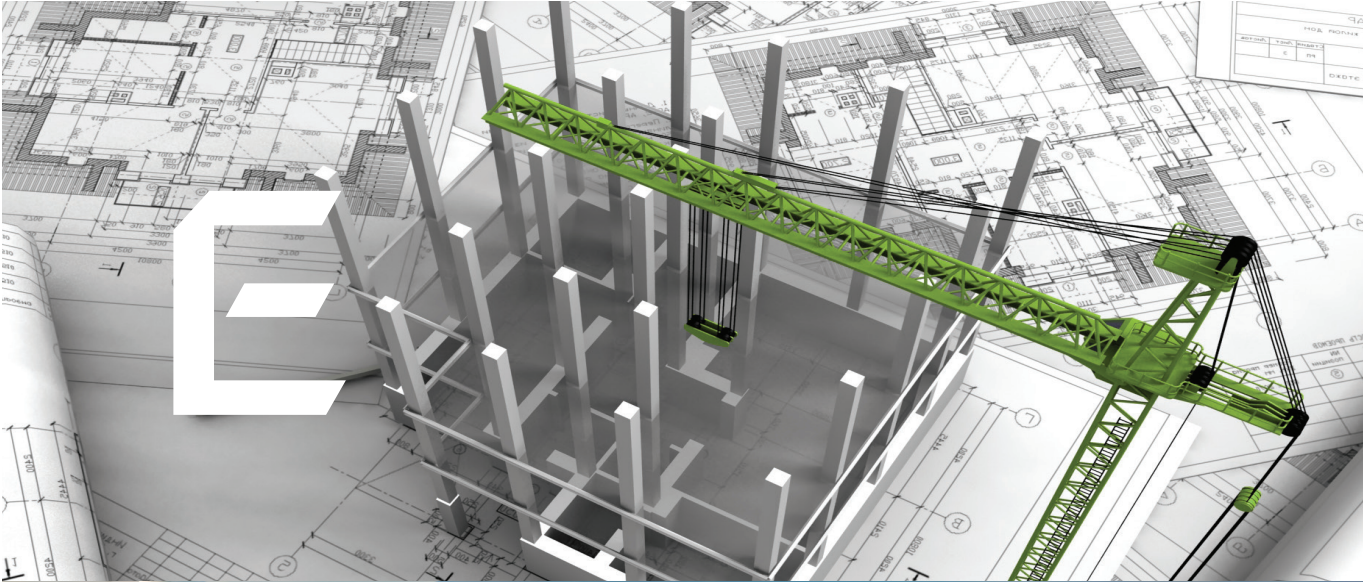
Industrial Clean, Dry, Bio Clean, Internet Data...

Room

Engineering, Energy, Environment

Management

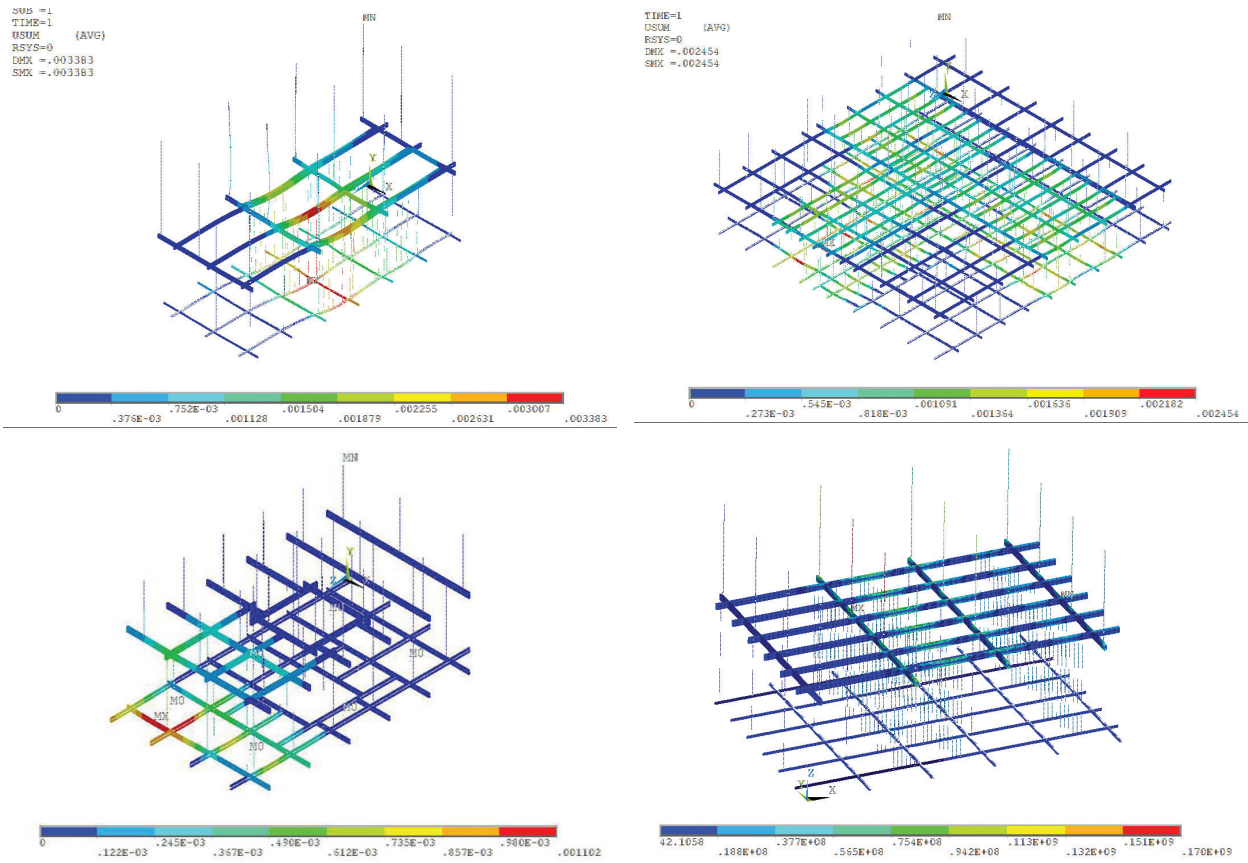
System



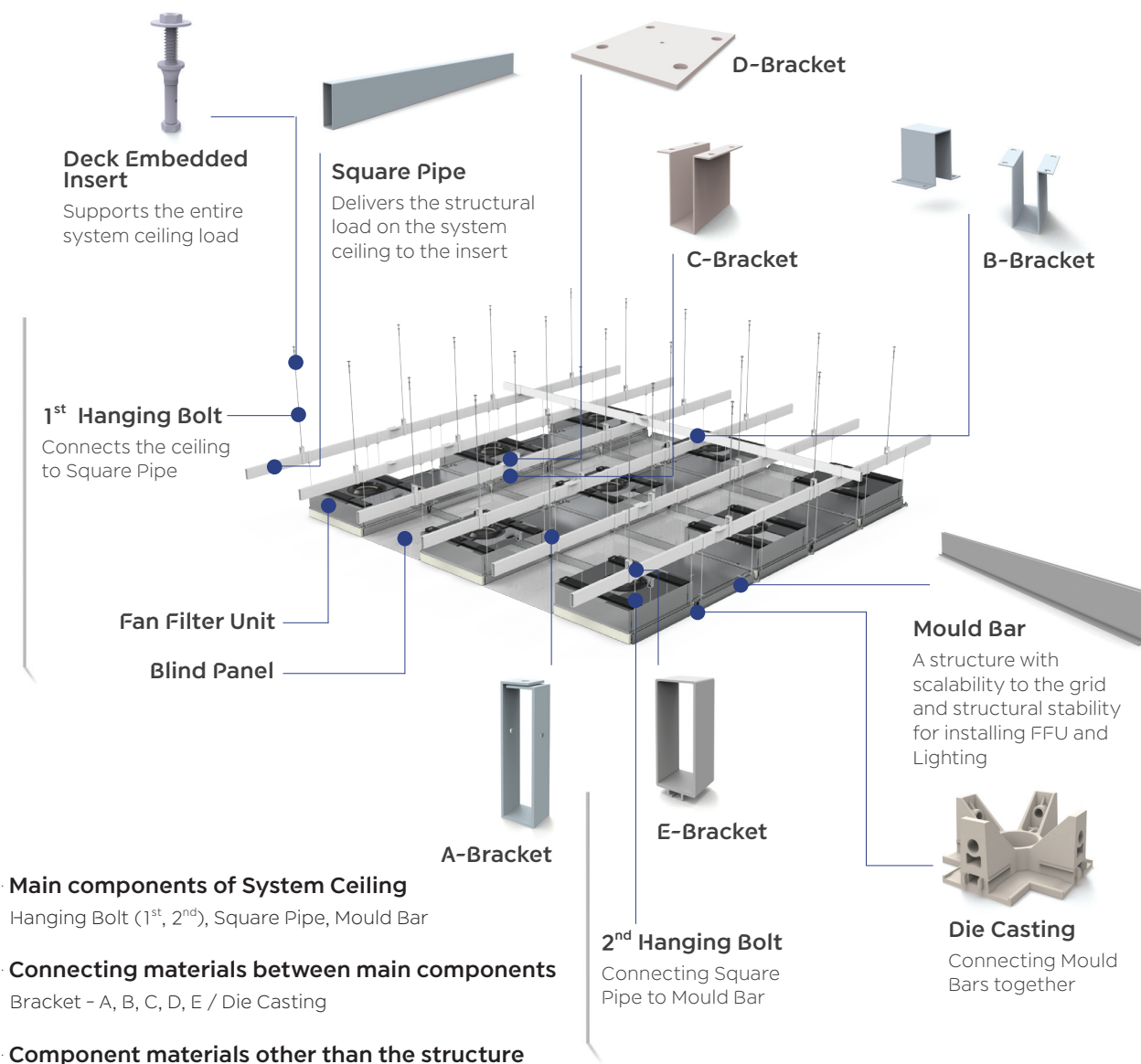
Suspended Ceiling System

This structure installed on the ceiling inside the clean room is equipped with FFUs, filters, blind panels, lighting, etc. to control cleanliness, temperature, humidity, and airflow in the clean room.

- A variety of designs and constructions are possible using our proprietary brackets
- Space scalability makes it easy to change the layout
- Enhanced safety and shortened construction periods are achieved through modular manufacturing methods



Classification	Deflection Limit	Classification	Maximum Allowable Stress
Total	Within 2.0 mm (or within L/240mm)	Hanging Bolt	Within 80MPa



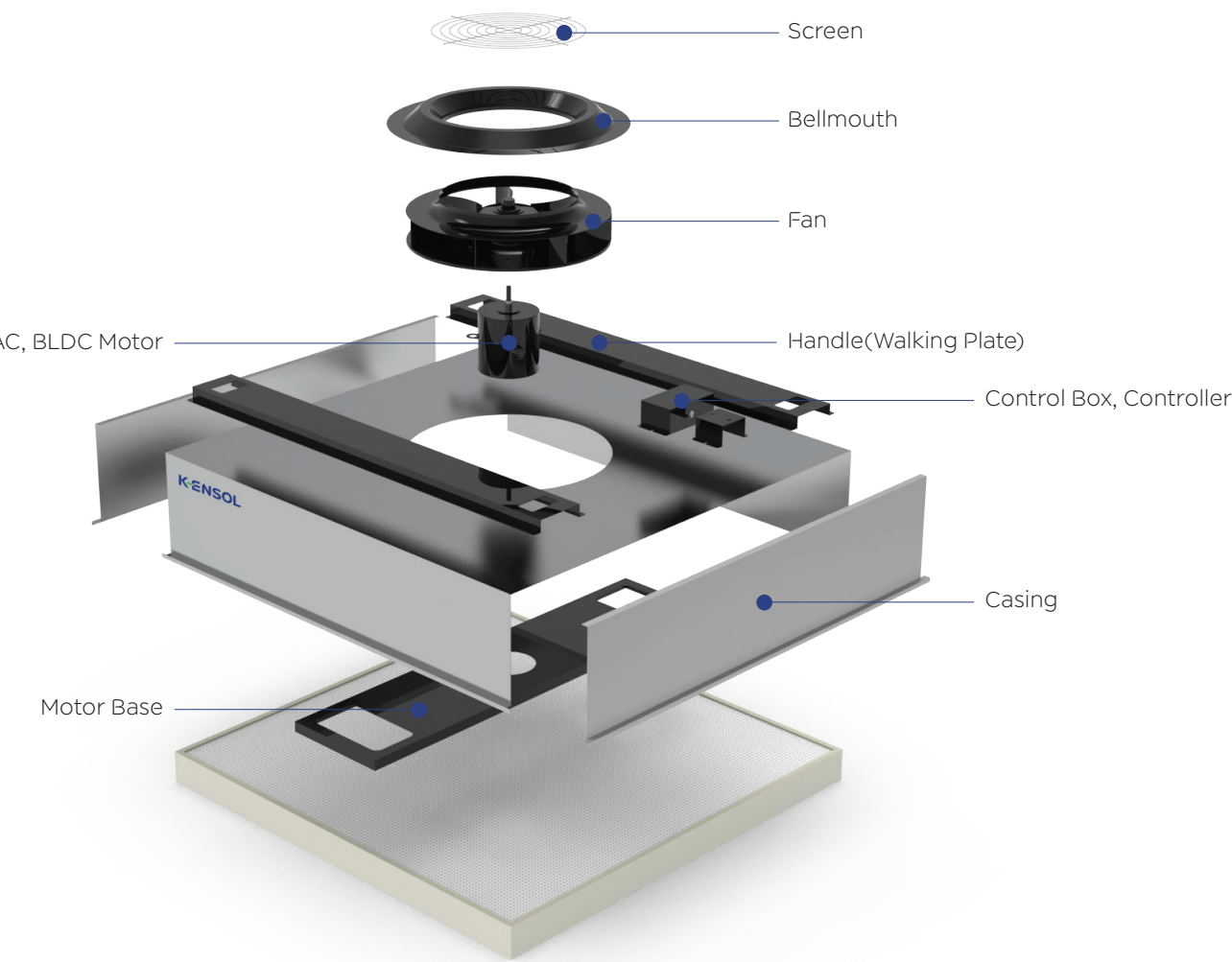
- **Main components of System Ceiling**
Hanging Bolt (1st, 2nd), Square Pipe, Mould Bar
- **Connecting materials between main components**
Bracket - A, B, C, D, E / Die Casting
- **Component materials other than the structure**
FFU, Lighting, Blind Panel



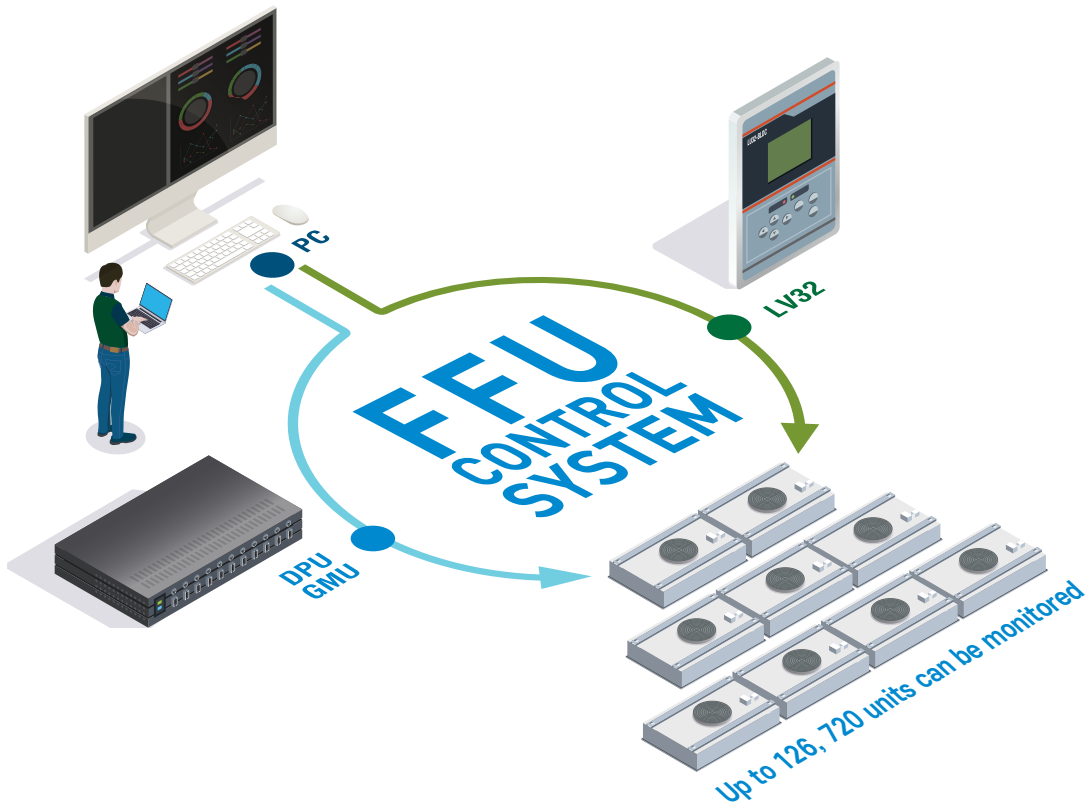
FFU Fan Filter Unit

This is a key device installed on the ceiling of a clean room to supply clean air through a filtering process that maintains Class 1~100 in cleanliness.

- High-efficiency AC & BLDC Motor
- Reduced power consumption
- Reduced operating costs
- Group/individual operating control and monitoring functions



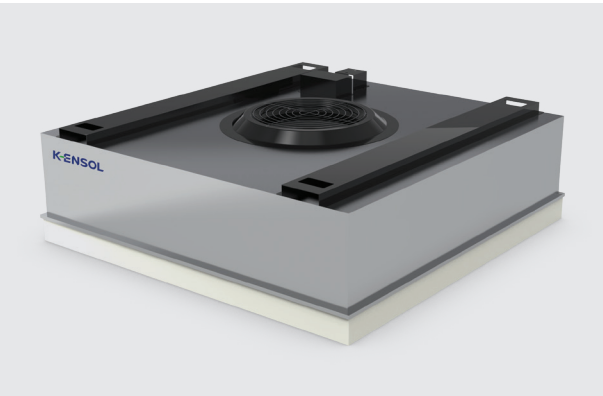
FFU Automatic Control System



Motor Type	BLDC Type (1 $\varnothing$ x 200~240V x 50/60Hz), AC Type (3 $\varnothing$ x 200~220V x 50/60Hz)			
Air Velocity(m/s)	0.1 ~ 0.7			
External Static Pressure(mmAq)	0 ~ 15			
Filter Spec.	Initial Pressure Drop 9.5mmAq at Air Velocity 0.35m/s , 99.9999% ULPA @0.1 μ m			
Dimension (LxWxH, mm)	1,282 X 1,475 X 304	725 X 1,282 X 304	1,177 X 1,177 X 304	577 X 1,177 X 304



All-in-one lighting FFU

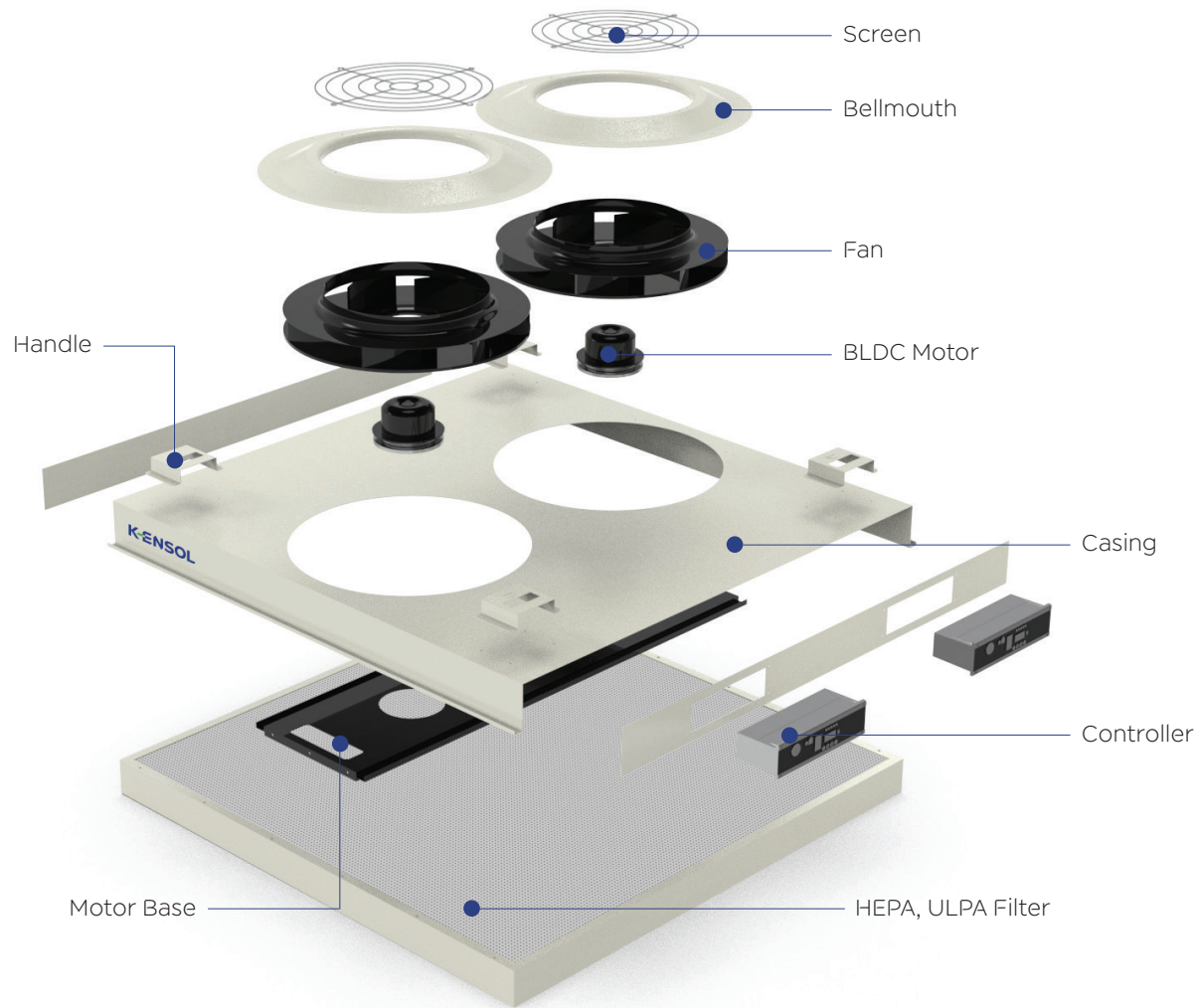


Standard FFU

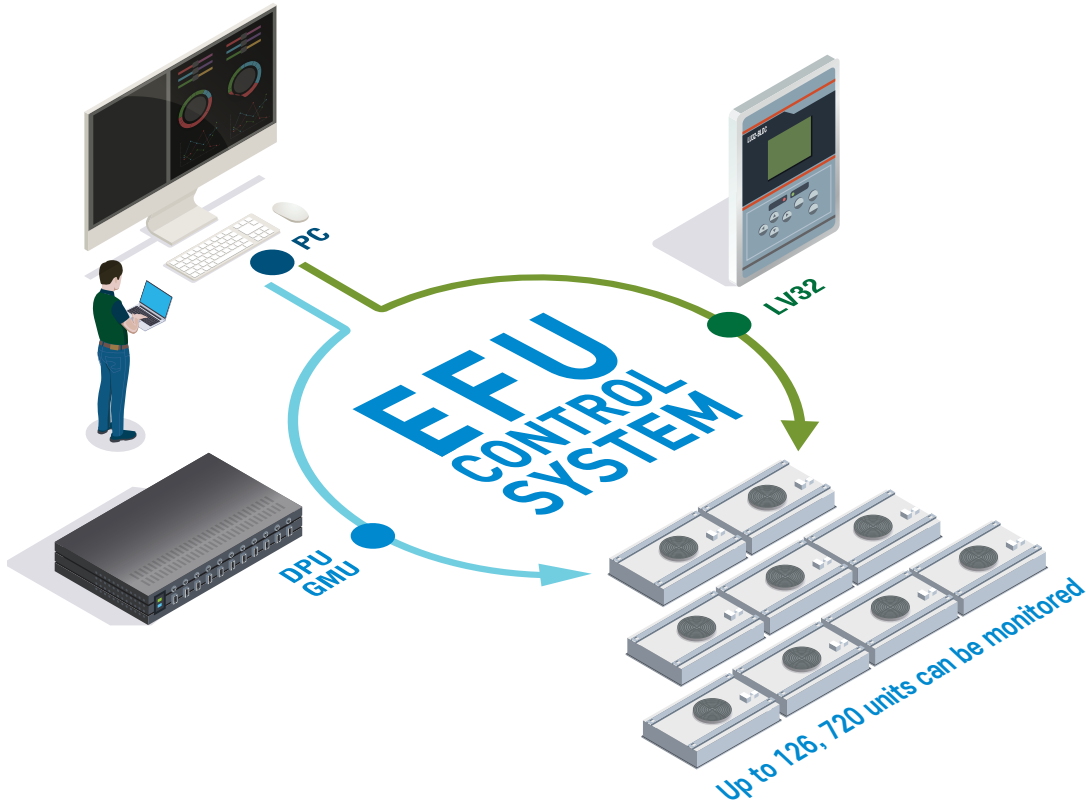
EFU Equipment Fan Filter Unit

This is a device installed on the top or side of a production facility to maintain positive pressure inside the equipment. It also maintains a high level of cleanliness inside of the equipment through the supply of clean air.

- Slim equipment (180mm including filter height)
- BLDC Motor
- Reduced power consumption
- Reduced operating costs
- Group/individual operating control and monitoring functions



EFU Automatic Control System



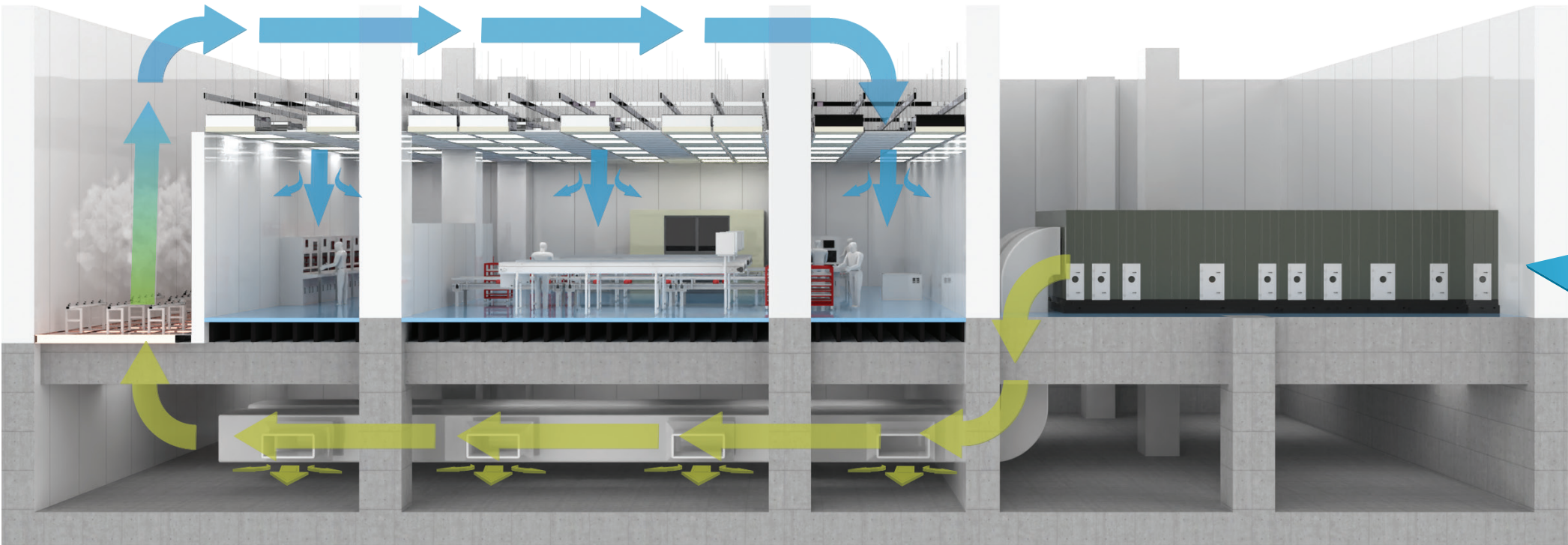
Motor Type	BLDC Type (1Ø x 200~240V x 50/60Hz)			
Air Velocity(m/s)	0.1 ~ 0.7			
External Static Pressure(mmAq)	0 ~ 4			
Filter Spec.	Initial Pressure Drop 9.5mmAq at Air Velocity 0.35m/s , 99.9999% ULPA @0.1μm			
Dimension (LxWxH, mm)	972 X 972 X 293	1,167 X 572 X 180	1,250 X 1,000 X 218	1,500 X 1,300 X 180



OAC Out Air Conditioner

This is a device located outside the clean room that controls positive pressure and cleanliness in the clean room by supplying air of a controlled temperature, humidity, and cleanliness into the clean room.

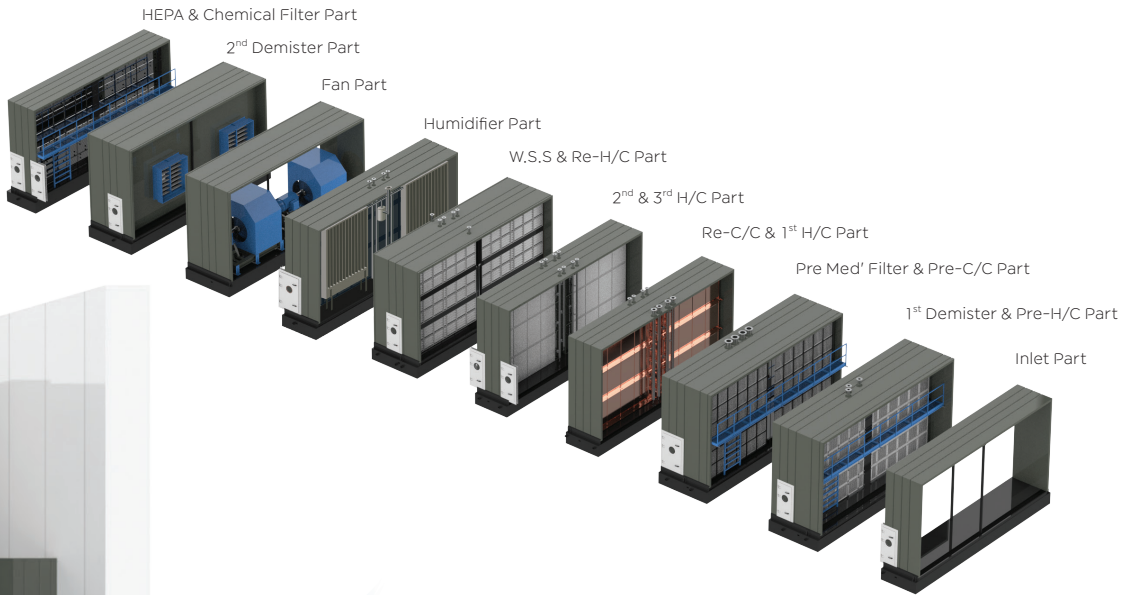
- Positive pressure in the clean room is maintained through the use of a large-scale fan
- A supply of extremely clean outdoor air that's optimized for clean rooms is provided through the utilization of high-performance filters
- Enhanced safety and shortened construction period is achieved through modular manufacturing methods



OAC Specification

Type		Specification
Components	Body	Casing, Frame Structure
	Transportation Devices	Centrifugal Air Foil Fan
	Heat Exchangers	Cooling & Heating Coil
	Humidifier	Steam Humidifier, WSS
	Filters	1 st , 2 nd Demister
		Pre Filter(AFI 70~85%)
		Medium Filter(NBS 60~90%)
		HEPA Filter(DOP 99.97%)
		Roll Filter
		Chemical Filter
	Miscellaneous Devices	Coil Louver, Back Draft Damper, SL Frame, Catwalk etc.

· The built-up type and module type can be designed, manufactured, assembled, and constructed



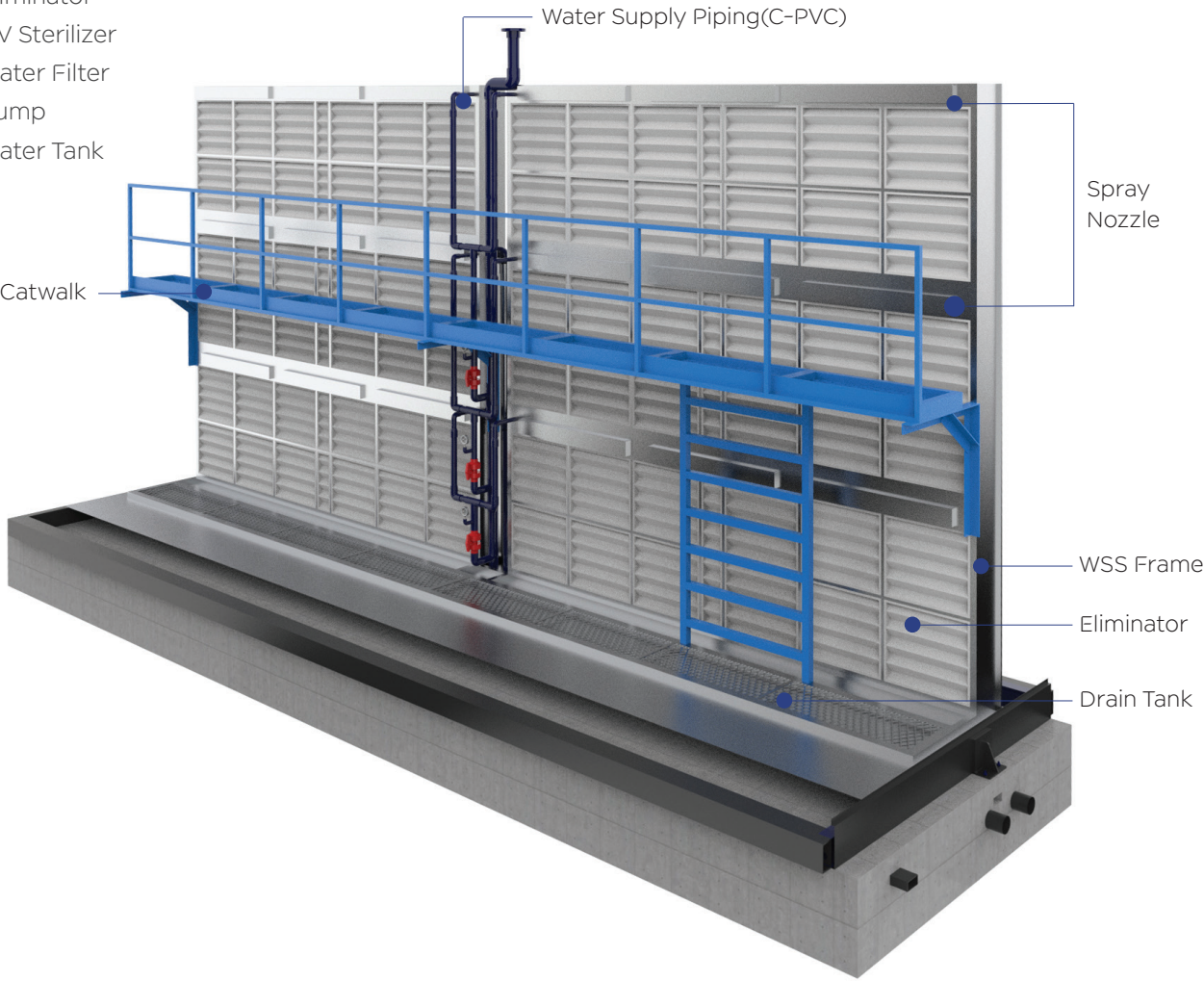
WSS Water Showering System

This system removes ionic gas from outside air while also providing a humidification effect

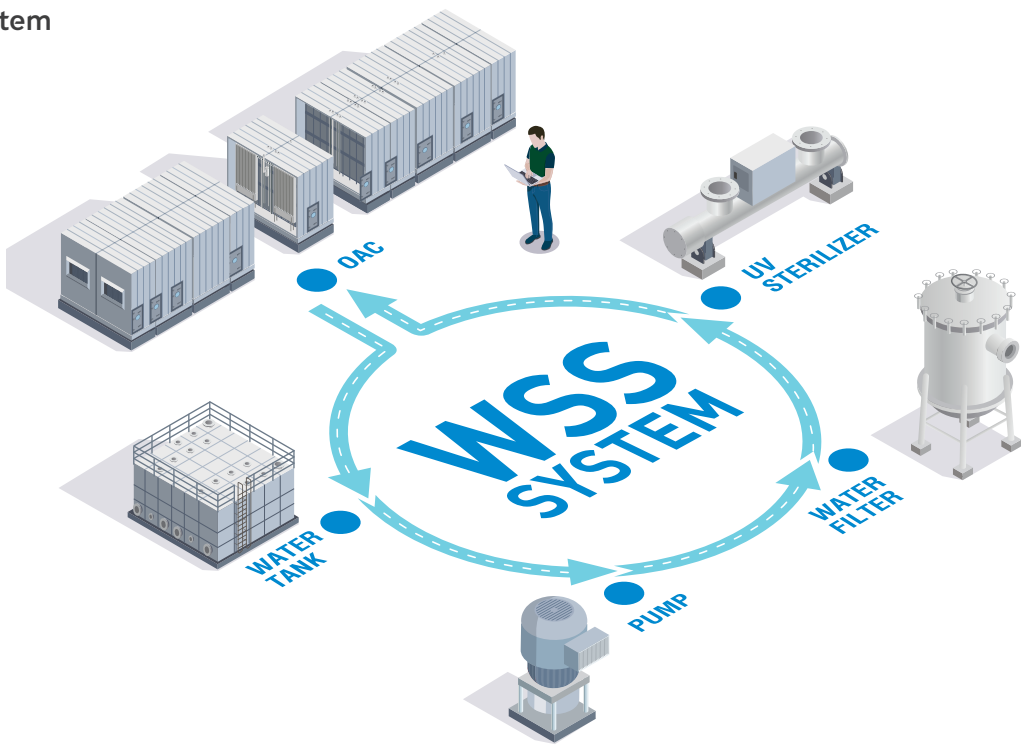
- The inorganic antibacterial agent applied to the eliminator has an antibacterial effect and inhibits slime formation
- It is divided into “Eliminator Split Type” and “Bulk Type” and can be applied to various sites
- Gas removal efficiency(NH3>80%, SOx>70%, NOx>30%)
- Excellent humidification performance ⇒ energy saving due to steam load reduction

Main components of the WSS system

- Eliminator
- UV Sterilizer
- Water Filter
- Pump
- Water Tank



WSS System

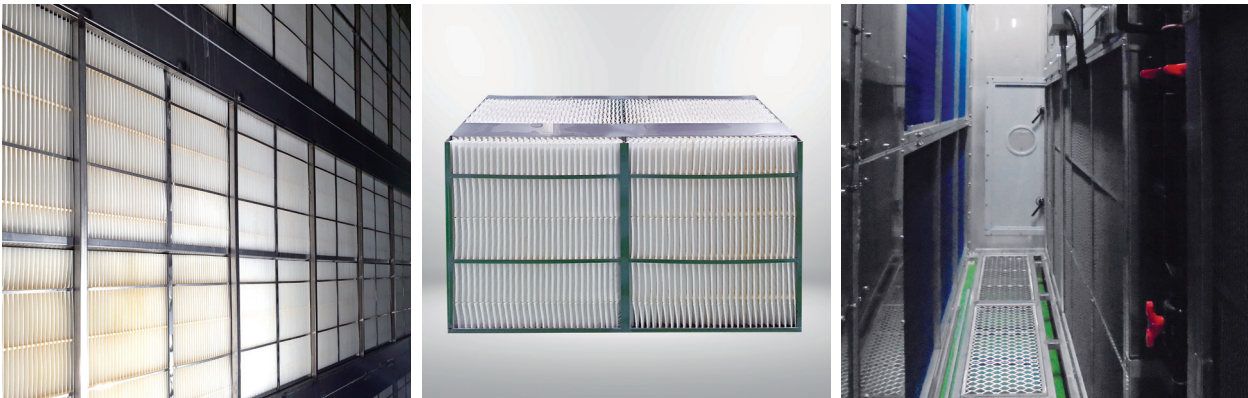


WSS Spec.

Liquid to Gas Ratio	0.05
Air Velocity	2.5~3.0m/s
pH	5.8~6.2
Supply Water	DI Water
Saturation Efficiency	85% over

WSS Quality Standards

Division		Spec.
Eliminator Hydrophilicity		60sec less than
WSS Gas Removal Efficiency	NH ₃	> 80%
	SO _x	> 70%
	NO _x	> 30%
Ion		< 10μg/L
Operating Differential Pressure		< 10mmAq
Out-gas		TVOCs < 30μg/L

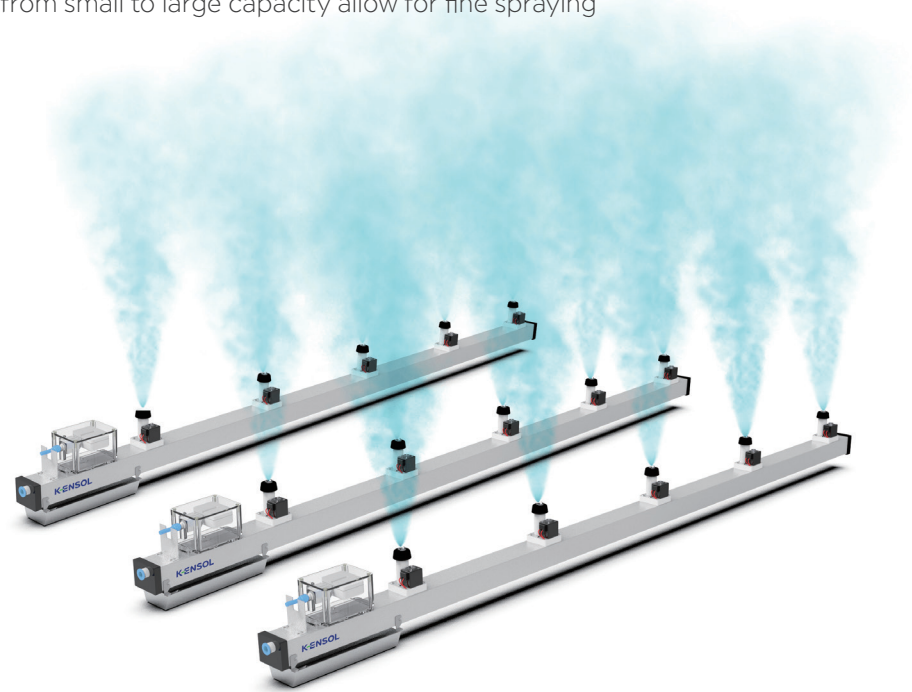


PMS

Plenum Moisturizing System

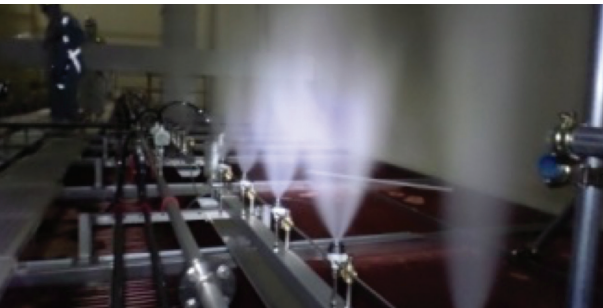
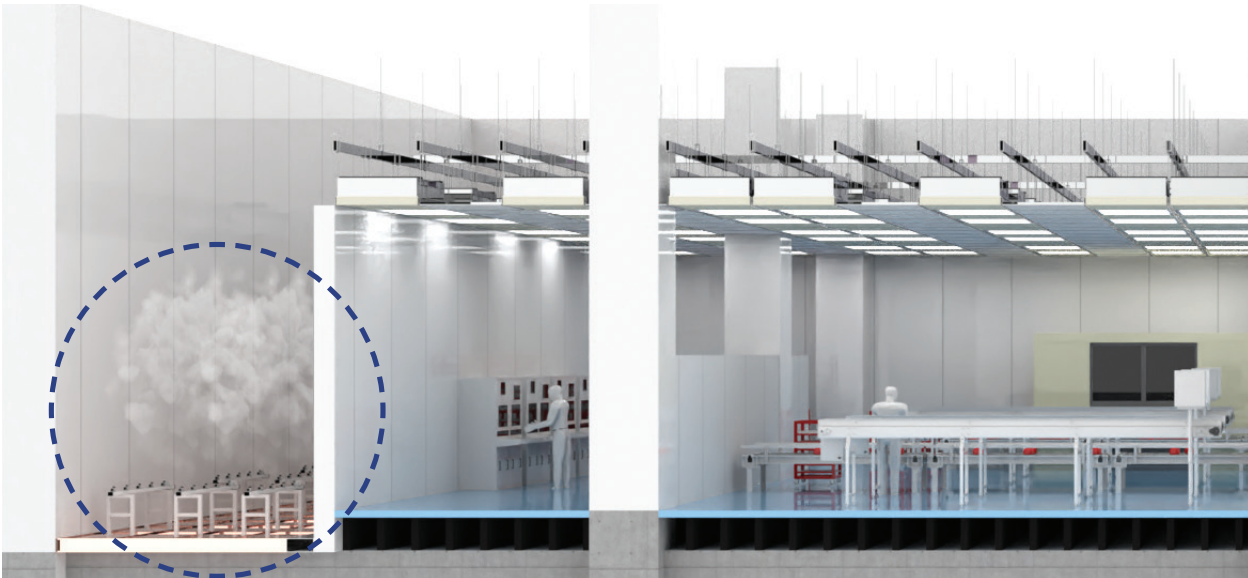
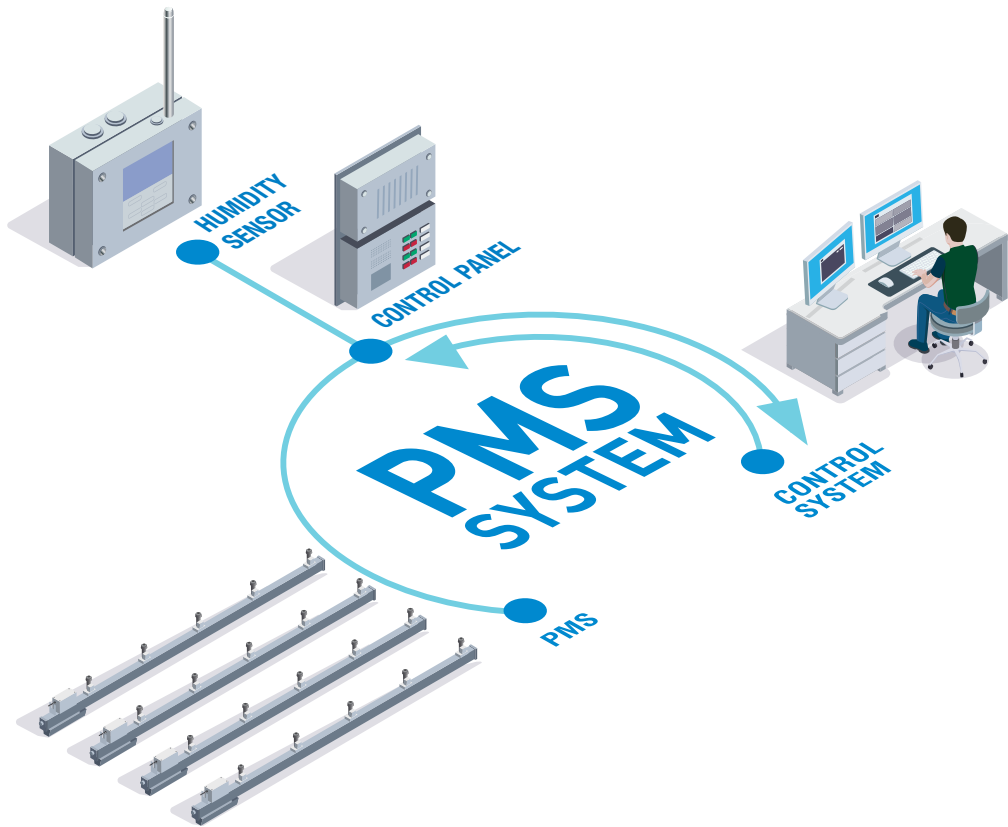
A humidity control system that humidifies by spraying moisture into the ventilation shafts inside the clean room.

- Up to 85% better energy saving rate compared to the existing humidification operation method
- This efficient operation can recover investment costs in a short period of time(in 2-3 years)
- Welding-free unit configurations allow for safer construction and are ideal for clean environments
- Multi-nozzle units, sized from small to large capacity allow for fine spraying



Classification	D-Nozzle(General Type)			S-Nozzle(CDA Reduction Type)			
	D75	D60	D50	S75	S65	S55	S45
Nozzle Method	Siphon Method						
	Liquid Automatic Suction Method						
Air Consumption	2Nm³/h(Air Pressure:3kg/cm 2 standard)			1.3Nm³/h(Air Pressure: 3kg/cm 2 standard)			
Water Spray Rate	4.0kg/hr	2.5kg/hr	2.0kg/hr	4.0kg/hr	3.0kg/hr	2.0kg/hr	1.0kg/hr
Vaporization Distance	4.0m	3.0m	2.0m	4.0m	3.0m	2.0m	1.5m
Average Spray Particle Diameter	SMD 12 μm	SMD 10 μm	SMD 9 μm	SMD 12 μm	SMD 11.8 μm	SMD 11.2 μm	SMD 10.7 μm

PMS System



K-Ensol works with major clients around the world.
We will deliver greater value and success to your company
with our proven technologies.



Samsung Electronics
Hwaseong, South Korea



Samsung Electronics
Pyeongtaek, South Korea



Samsung Electronics Taylor,
USA



Samsung Semiconductor
Xian, China



Samsung Display Asan,
South Korea



Samsung Display Cheonan,
South Korea



LG Display Paju,
South Korea



LG Display Gumi,
South Korea



SK Hynix Cheongju,
South Korea



SK Hynix Icheon,
South Korea



SK Hynix Wuxi, China



SK Siltron Gumi,
South Korea



STATS ChipPAC Incheon,
South Korea



ITEK Semiconductor Hwaseong,
South Korea



Tesla Inc. Anseong,
South Korea



Komico Wuxi, China



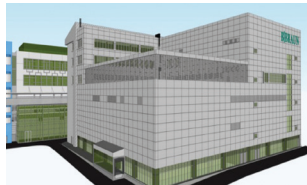
SK Battery America Georgia,
USA



Samsung Electro-Mechanics,
Vietnam



STMicroelectronics,
Singapore



B.BRAUN, Malaysia



Hyundai Motors Guangzhou,
China



Takasago Thermal Engineering
Innovation Center, Japan



LG Innotek, Vietnam



Global ZEUS Hwaseong,
South Korea